By Charlie Schwindamann, Wastewater Tech

An Introduction to Wastewater Collection System Operation

This article will focus on the lagoon operation issues that KRWA staff commonly encounter when contacted by utilities. There are three things every operator should review to be familiar with concerning their wastewater system. They are: 1) the systems permit, 2) the system's ordinances, 3) the system design. These three items are essential to operating the system properly.

The permit . . .

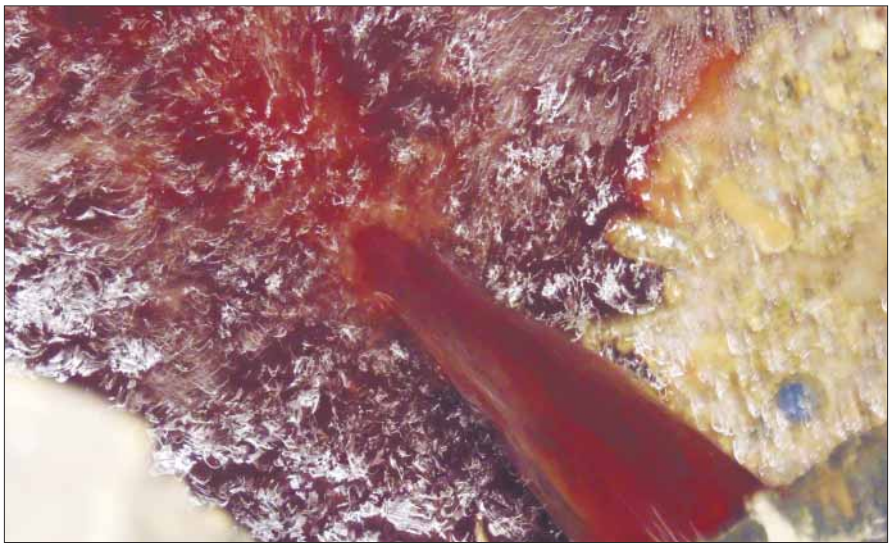
The permit details the requirements of the regulations from KDHE and EPA, including discharge permit limits for discharging systems, and the operations and maintenance requirements for the entire wastewater system including the collection and treatment facilities. The regulations inform the operator what is required but not how to complete these tasks. KRWA has developed a Lagoon Basic Operations Guide to assist operators in day-to-day operations. The guide explains what tasks should be completed daily to annually. KRWA has also developed a basic operations guide for water systems for systems using wells. Either of these can be adapted to fit specific system needs as some wastewater systems have lift stations others do not, and some small water systems purchase their water instead of treating water. These guides can be found at https://krwa.net/TECHNICAL-ASSISTANCE/Downloads. The Lagoon Basic Operations Guide has four sections: 1) lift stations; 2) collection system; 3) lagoons; and, 4) operations guide and emergency response plan.

BOD and TSS . . .

Ordinances are the rules the systems have for everything from connections and fees to what is allowed to be discharged into the sanitary sewer system. A few of these will regulate the allowable strength of the Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) being discharged from customers. BOD and TSS are usually limited to a maximum of 300 mg/l each due to the treatment design and process which reduce them to allow the waste to meet permit limits when discharged. We often find the problem is because customers discharge high-strength waste such as blood from a locker plant.

Often, the operator determines where the high-strength waste is coming from. Frequently, the board/council members do not want to enforce the ordinances as they do not want to lose a business. But suppose the high-strength waste causes major issues and failure to meet permit limits, and upgrades to the treatment facilities cost millions of dollars. Is it worth the cost to the rest of the customers because one is not required follow the ordinances? In my opinion, No! It is not worth the added cost to other customers in most cases.

Sometimes it is very difficult to troubleshoot and conclude why the system is failing permit limits. It could be high-strength waste that cannot be seen, but is discovered as result of the influent sampling. Several years ago, KRWA found a system failing permit limits and could not determine the cause as the influent, when sampled in the morning, was within normal range. Excessive stormwater in the sewer was



This photo shows blood from a locker plant entering the city's lift station. While the photo indicates the blood is diluted by other flow, high BOD of more than 100,000 mg/l is not uncommon for whole blood from locker plants.

Bar screens help remove solids from entering the lagoon system. These usually require cleaning on a daily basis. The mechanical bar screen on right removes much more debris and usually only requires weekly maintenance.

not an issue either. It was recommended that the system collect samples at different times of the day, such as mid-morning, early afternoon, and mid-afternoon in areas where possible discharge was highest such as near restaurants, the grocery store and schools. This proved to be part of the solution as it was discovered there was high BOD and TSS entering the system in the early-afternoon at the downstream manhole from the school. It was found that the school was disposing of all leftovers from lunch through the garbage disposal into the collection system. The solution was simple – scrape the food trays into the garbage to remove most of the food. The BOD downstream from the school was approximately 5,000 mg/l. Normal BOD is 200 to 250 mg/l. This solution worked well for more than a year until the new staff began at the school and they had to be educated on the proper disposal of the food waste. This is an example of finding issues with high BOD, looking for where is possibly high waste coming from, and sampling upstream and downstream at different times of the day and sometimes different days. Some such as blood from the locker plant can be found by checking manholes on processing days.

It was found that the school was disposing of all leftovers from lunch through the garbage disposal into the collection system.

The collection system

New operators should review the design plans of the collection and treatment system to understand how the waste flows through the collection system to the lift station and force main to the treatment facilities. Collection systems should have a minimum of an 8-inch pipe as required by KDHE design standards. The plans should show the operator the depth of the mains, location of manholes and service connections when constructed. The plans for the lift stations will provide the depths of inlet pipes, the size of the discharge piping, and the depths of the floats if controlled by a float system.

Newer lift stations use a variety of control systems such as floats, sonar, bubbler, and pressure transducers for turning the pumps on and off and for alarms. All of these work well in most cases, and all have specific maintenance needs to keep them in proper working order. Operators should become familiar with the maintenance required for their systems lift station's pumps, motors, and control systems.

Once the wastewater has reached the lagoons, either by gravity or force main, it enters the influent structure. Some systems install a bar screen at this location to catch the debris. Some systems are now installing mechanical bar screens at the lift stations before the pumps.

Bar screens will reduce failure of pumps due to clogs and wear of the impellers. "Flushable wipes" is the most significant cause of pump failures due to clogs. I recommend that any system upgrading any part of their system, collection or treatment, install a mechanical bar screen. A bar screen will reduce the amount of buildup of solids at the lagoon, which will reduce the frequency of removing sludge/debris from the lagoons.

Blockages

KRWA often receives calls about blockages in the influent lines to the lagoons. Blockages can be due to excessive debris such as handy wipes. Frequently the inlet pipes are on the floor of the cell. When sludge accumulates, it plugs the line and no flow enters correctly and bypasses to the next cell. If the bypass occurs, the operator is required to notify KDHE. This is why daily inspection of all the structures at the lagoon is recommended.

KRWA has assisted several systems with these blockages during the past several months.

Sewer Muni-Ball plugs work in all types of pipe. Muni-Ball Plugs have a threaded aluminum bypass. They allow sewer flow to pass through the plug via a pump hose in addition to simply blocking flow.

These two photos show erosion of lagoon dikes. Erosion could be significantly reduced or eliminated if all lagoons had erosion control. KDHE minimum design standard states in part "Erosion protection for all wastewater stabilization pond structures, regardless of size, shall be considered. Erosion protection via the use of concrete, asphaltic aprons, baffles, stone riprap, or artificial membranes shall be utilized on pond cells of 3.0 acres or larger such that the windward embankment slopes affected by prevailing wind(s) will be protected.

KRWA uses Muni-Ball plugs and a pump to force water through the pipe, and open it to flow again. The Muni-Ball is placed into the plugged pipe so the entire Muni-ball is in the pipe, the ball is inflated to 35 PSI. A trash pump is connected to the Muni-Ball and then turned on and allowed to flow for at least 15 minutes, depending on the blockage and debris seen floating in the cell. I recommend wastewater systems purchase a Muni-Ball plug and use it at least quarterly to keep the line open, as blockages are likely to occur. Blockages can occur in any structure of the lagoon system so all structures should be checked visually at least three times per week.

Dike erosion

The next most common problem KRWA is contacted about concerns erosion of the dikes and how to repair them. The answer varies greatly on the severity of the erosion. While some are minor, others are severe with near-complete failure of the dikes as more than half may be eroded. Those with severe dike erosion need engineering and professional contractors to return to like-new conditions.

A small system recently purchased enough three to four-inch filter rock riprap to go around three cells with a total surface of 1.55 acres. The project required 385 tons to achieve one foot of depth, five feet wide. The cost was approximately $14,000 and another $2,000 to have it placed by a contractor as this system has no equipment. To prevent further erosion, the system opted to install the riprap before the problem worsened.

Sometimes it is very easy to troubleshoot a discharging lagoon system that is failing to meet permit limits. Often the failure to meet permit limits is easily corrected, such as plugged pipe at the lagoons, or the weir plates being in the wrong position for proper operations and the operator is not aware of the correct flow pattern of the system. Weir plates should be placed to allow flow to enter the first cell, then the second, then to the final cell and then discharge.

The most common cause for failure of permit limits, in my experience, is excessive stormwater entering the sanitary sewer system. This is referred to inflow and infiltration or I&I. This can be corrected by lining the collection piping system, manhole rehabilitation and sealing service line taps. This is determined by low influent BOD and TSS test results, usually less than 100 mg/l. Another way to determine excessive I&I is lift station pump hours will significantly increase during rain events.

Another cause for failure might be where there is excessive sludge. KRWA can conduct a sludge profile to determine if it is the cause. I recommend a profile be part of the evaluation when permit limits have failed. KDHE recommends considering sludge removal when the sludge depth is 16 inches or more in two cells. With this amount of sludge, it would like operating one cell at the normal depth, then the other at 2.5 feet. This is a significant reduction of detention time.

Sludge removal is usually necessary every 20 to 25 years. This is why KDHE also recommends that a sludge profile be conducted every ten years. A sludge profile is a service KRWA provides at no cost to systems. We do have an extensive list so it may not be completed immediately but during the summer or fall months. Sludge removal from a lagoon can be expensive. At a budget estimate of $0.07 per gallon, it will cost approximately $45,600 per acre for two feet of sludge removal. KRWA recommends a reserve account be established to pay for such projects.

These photos show sludge being pumped from a lagoon to a tractor pulling an injector in a soybean field.

In conclusion

It was not all that long ago (in the late 19th century) that people living in cities and the countryside used cesspools and privies to dispose of domestic wastewater. But because of increasing awareness of waterborne disease and the popularity of indoor plumbing and flush toilets, sanitary sewer systems were developed. While today's communities have many challenges, it is important that community leaders understand the importance of properly maintaining the wastewater system. KRWA staff have decades of experience working with both water and wastewater systems, from training new operators to helping locate and remove a plugged sewer line. Give KRWA at call at 785/336-3760 if you have any question about your utilities. Someone will answer and help with be on the way.

Charlie Schwindamann has been a Wastewater Tech at KRWA since September 1999. Charlie holds Class II Water and Class I Wastewater Operator certification. He has also served as a member of the Marysville, Kansas city council.